THE
Sidereal Messenger.

Conducted by Wm. W. PAYNE,

Director of Carleton College Observatory.

SEPTEMBER, 1883.

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"To impress upon the mind the reality of the perfection of the works of the omnipotent, the living GOD."—Professor JAMES C. WATSON.

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XUM

THE CONSTANT OF ABERRATION AND THE SO-LAR PARALLAX.

BY PROF. A. HALL.[*]

MR. OTTO STRUVE, Director of the Pulkowa observatory, has recently published an interesting synopsis of the various determinations of the constant of aberration made at that observatory since its establishment in 1843. These determinations are as follows.

OBSERVER.	INSTRUMENT.	CONSTANT OF ABERRATION.
W. Struve	Prime Vertical Transit	20.″463 ± 0.″017
Schweizer	Transit Instrument	20. 498 ± 0. 012
Peters	Vertical Circle	20. 507 ± 0. 021
Gylden	Vertical Circle	20. 469 ± 0. 026
Wagner	Transit Instrument	20. 483 ± 0. 012
Nyren	Vertical Circle	20. 495 ± 0. 021
Nyren	Prime Vertical Transit	20. 517 ± 0. 014

When we consider that these values have been found by six different astronomers, using three different instruments, and that the constant errors peculiar to the observer and the instrument have entered into the results, the values given above are wonderfully accordant. We may fairly conclude that all further observations made at the Pulkowa observatory will not sensibly change the value of this constant. The mean value is

Constant of Aberration = 20.″492.

This value is a little greater than that adopted in our Nautical Almanacs, which is 20.″4451.

In order to deduce from the constant of aberration a

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value of the solar parallax we must know the velocity of light, and for this purpose I take the recent determinations of this velocity by Michelson, Cornu and Newcomb, which are as follows:

Michelson 299,940 kilometers per second
Cornu   300,400   "   "   "
Newcomb 299,717   "   "   "

The method used by Michelson and Newcomb is a modified form of Foucault's revolving mirror: while Cornu's value was found by the method of Fizeau. If we combine these values with the new constant of aberration, 20.″492, we have

With Michelson's value solar parallax = 8.″791
"   Cornu's   "   "   "   = 8. 778
"   Newcomb's "   "   "   = 8. 798
                   Mean value = 8.″789

This value agrees well with that found by Mr. David Gill from his heliometer observations of *Mars* in 1877, which gave 8.″78; and it does differ greatly from the value 8.″76 published by Powalky in 1873.

There are several objections to the above method of finding the solar parallax. Thus it will be noticed that the discordance in the values of the velocity of light far exceed the probable errors of the separate determinations as estimated by the observers; for example, the probable error of Michelson's value is only ±51 kilometers, and considerably less than this by the common method of probable errors. But such discordances are a matter of common experience, and we may ascribe them to constant errors peculiar to the various methods, and which probably can be removed by careful investigation of the apparatus and the methods of the experiment. But there are other objections. The motion of the solar system in space will have its effect on the constant of aberration, as was noticed by Bessel, Tab. Reg. p. xix. But from what we now know of this motion its effect on this constant is very small, probably not affecting more than the third decimal figure of its value. The same may be said of the change produced by the motion of the

Sun and *Earth* around their common center of gravity, and those produced by the perturbations of the *Earth*. Another objection comes from the theory of light, and Villarceau of Paris thinks the aberration will vary with the latitude of the observer. These two causes, if they exist, will probably produce only extremely small errors in the value of this constant. Still it seems to me that it would be well if this constant could be determined at other observatories and by different methods. Perhaps the old method by means of the satellites of *Jupiter* may give a good result if improved methods of observing can be applied

If now we make a fair allowance for all these errors still I think that this method of determining the solar parallax is the most exact that we have. We know how astronomers have deduced various results from the contact observations of the transits of *Venus*, and how they have disputed over the question of the "black drop" etc. In fact there is such a vagueness about these observation that though they may have a certain optical and physical interest they seem to me to have but little scientific value. If we glance at the observations of contact made along our eastern coast last December we shall find a range of thirty seconds of time, and yet almost every observer is sure that he is not more than one or two seconds in error. But errors of ten and twenty seconds may be expected when we recollect that a single second of arc corresponds to about twenty seconds of time, and thus a little mal-adjustment of the telescope, or mistiness of the sky or straining of the eye can easily produce an error of half a second of arc. By this method we get a large amount of uncertain data which may be weighted and combined according to the judgment or whim of the astronomer, and which leads to endless discussion. Even if some ingenious astronomer should combine into one final result all the contact observations of the last four transits of *Venus* and bring out the value 8."789 no doubt some one would declare him wrong.

The only other method from which we have results of the transit of *Venus* in 1874 is the American photographic method, and in this case the result is below our expectation. In

the first place the probable error of a single photograph is two or three times as great as was expected, and although if these errors were purely accidental we might hope for a good result from a large number of photographs even under these conditions, yet it seems probable that constant errors may exist in this method. Some of them have been enumerated by Professor Newcomb in his report on these photographs, p. 103, but there is another which has not been much considered. The optical part of the photoheliograph is composed of an objective and a plain mirror from whose combined action the image is found. If these mirrors are plain surfaces, or if they have the same radii of curvature while the photographs are made no sensible error would arise from this source, but if the mirrors at the southern stations are exposed to a different temperature and hence have a different figure than those at the northern stations it seems quite possible that an error would be introduced into the result that would not be eliminated by increasing the number of photographs. Probably this error would be small, but the quantity we wish to determine is less than a tenth of a second of arc.

The old and simple method of determining the parallax from observations of *Mars* made at northern and southern stations has been applied several times in recent years, but the lack of harmony in these observations is a great drawback. It appears to be exceedingly difficult for an experienced astronomer to conform to anybody's plans but his own, and hence we have anomalies in these observations for which we need not seek the rather fanciful reasons sometimes assigned. The best method of dealing with this planet, or with an asteroid, is probably the one so well executed by Mr. Gill in 1877; that is by observing east and west of the meridian, so that the observer and the instruments are the same, and there is less opportunity for constant errors to vitiate the result.

It does not seem worth while to speak of the methods of theoretical astronomy for finding the value of the solar parallax, since there is great difficulty in some cases in determining the coefficients with the required accuracy, and in

others it will be a long time before this can be done.   In fact
so far as the needs of the astronomer are concerned we may
say that the solar parallax is known well enough now; since
what he wants is to reduce his observations with sufficient
accuracy, and it concerns him but little whether the *Sun* is
92 or 93 millions of miles away; but it is well to push the
determination of all constants to the utmost accuracy, and
by different methods.   The method mentioned at the begin-
ning of this paper seems to promise the most accurate re-
sult.   The two constants which enter into this determina-
tion are snbject to continuous and exact investigation, and
it is from such methods, I think, that we may hope for the
best results.

ON THE REDUCTION OF DIFFERENT STAR CATA-LOGUES TO A COMMON SYSTEM.*

BY WILLIAM A. ROGERS.

The communication of Professor Safford in the March
number of the Monthly Notices of the Royal Astronomical
Society, cites in a forcible way some of the causes of dis-
crepancies in stellar co-ordinates to which too little atten-
tion has hitherto been paid.   Incidentally he refers to the
class of errors which are introduced in the computation of
the systematic corrections necessary to reduce different cata-
logues to a common system. · Without this reduction it is
impossible to obtain the element, proper motion, with the
degree of precision which modern observations call for.

It is unfortunate that this necessity exists, since consid-
erable uncertainty must always remain in the determination
of these corrections.   One of the serious demands of instru-
mental astronomy, at the present time, is the independent
determination at a few widely separated observatories of all
the elements which define stellar positions, without direct
reference to any assumed fundamental system.   The Cata-
logue of A. G. Publication XIV. by Dr. Auwers is probably
more nearly free from systematic errors than any hitherto

*Read recently before the American Academy of Art and Science.

constructed; but the independent researches of Professor
Boss show that the fundamental observations in declination
from about 1815 to 1845 differ as a system from the Auwers-
Bradley system by an amount which cannot be neglected.

Since it is obviously impracticable to redetermine the in-
strumental constants with which the different catalogues to
be compared have been constructed, by a direct reference to
the fundamental system to which they are to be referred,
and with these constants to deduce new co-ordinates, we
must seek the best method of deriving the systematic cor-
rections required.   The general tendancy of modern practice
is towards the graphic method, in preference to a rigid an-
alytical determination.   But the difficulty exists that com-
puters do not agree in the details of the graphical methods
employed, and hence with the same data different results
are obtained.   It is the common practice to draw the curves
which represent the residuals in right ascension with this
function as the horizontal argument, but there are several
catalogues in which the residuals $\varDelta a$ are functions of both
the right asension and of the declination.

In the choice of any method, it is obvious that preference
must be given to that in which the residuals $\varDelta a$ and $\varDelta \delta$ are
reduced to a minimum, *whatever the order or the limits of the
groups into which they may be devided*.   It is believed that
this will be best accomplished by the use of what, for the
lack of a better term, may be described as double-argument
curves.

Suppose, for example, that all the residuals in right as-
cension for a given catalogue which fall within the limits
of the groups in declination $-10°\dots +0°$, $+0°\dots +10°$,
$+10°\dots +15°$, etc., are arranged in groups in order of right
ascension.   Since the values of the residuals may be as-
sumed to be true (nearly) for the mean of the groups into
which they are divided, whether the argument be the right
ascension or the declination, it is obvious that we can
choose either the values which are functions of the right as-
cension, or those which depend on the declination at pleasure
in the construction of the graphic curves.   But whichever is
chosen, the residuals derived from the constructed curves no

longer represent the mean values which correspond to the other argument; that is, the values which are functions of one argument are derived from the same curve, while those which are functions of the other argument are derived from different curves.

The character of these double-argument functions are illustrated in the following (fictitious) example.

$\triangle a$
TABLE I.

h. h.	+0° ... −10°	+10° ... +0°	+20° ... +10°	+30° ... +20°	+40° ... +30°	+50° ... +40°	+60° ... +50°	+70° ... +60°
	s.	s.	s.	s.	s.	s.	s.	s.
0.. 2	−.050	+.129	+.175	+.232	+.323	+.338	+.413	+.427
2.. 4	+.077	+.076	+.118	+.213	+.218	+.300	+.300	+.334
4.. 6	+.031	+.064	+.110	+.118	+.193	+.194	+.214	+.216
6.. 8	+.043	+.058	+.050	+.088	+.077	+.112	+.100	+.125
8..10	+.028	+.028	+.044	+.047	+.064	+.058	+.061	+.062
10..12	+.006	+.013	+.007	+.013	+.017	+.015	+.016	+.017
12..14	−.007	−.019	−.009	−.021	−.018	−.030	−.034	−.037
14..16	−.008	−.041	−.058	−.038	−.082	−.085	−.090	−.100
16..18	−.041	−.049	−.066	−.080	−.087	−.115	−.140	−.140
18··20	−.030	−.083	−.118	−.091	−.148	−.150	−.190	−.213
20..22	−.069	−.097	−.113	−.138	−.163	−.200	−.225	−.250
22..24	−.068	−.124	−.150	−.150	−.215	−.230	−.265	−.300

These residuals may be considered as representing the true deviation from the normal places, either 1^h, 3^h, 5^h, etc., or at $-5°$, $+5°$, $+15°$, etc.

If the right of ascension is assuned as the argument, we shall have from the curves represented by $\varDelta a$ the following:—

TABLE II.

h.	−5°	+5°	+15°	+25°	+35°	+45°	+55°	+65°
	s.	s.	s.	s·	s.	s.	s.	s.
1	+.072	+.106	+.163	−.235	+.290	+.350	+.415	+.425
3	+.062	+.087	+.130	+.180	+.232	+.280	+.300	+.322
5	+.050	+.072	+.097	+.130	+.170	+.200	+.207	+.220
7	+.037	+.053	+.060	+.087	+.112	+.130	+.130	+.128
9	+.027	+.033	+.033	+.047	+.056	+.067	+.067	+.060
11	+.013	+.014	+.014	+.016	+.010	+.018	+.018	+.011
13	−.009	−.006	−.007	−.018	−.030	−.032	−.037	−.040
15	−.020	−.026	−.025	−.047	−.060	−.079	−.087	−.090
17	−.033	−.045	−.045	−.073	−.093	−.117	−.137	−.143
19	−.048	−.070	−.071	−.105	−.123	−.157	−.186	−.205
21	−.060	−.100	−.120	−.133	−.150	−.197	−.226	−.257
23	−.077	−.127	−.127	−.160	−.165	−.233	−.260	−.306

The values in the horizontal columns, having been derived from different curves, no longer sustain the relation which existed in the corresponding values of Table I. They may be connected symmetrically by drawing a series of smooth curves with the declination for the argument, as shown in Table III.

TABLE III.

h.	$-5°$	$+5°$	$+15°$	$+25°$	$+35°$	$+45°$	$+55°$	$+65°$
	s.	s.	s.	s.	s.	s.	s.	s.
1	$+.053$	$+.112$	$+.170$	$+.228$	$+.288$	$+.347$	$+.407$	$+.452$
3	$+.048$	$+.092$	$+.138$	$+.182$	$+.228$	$+.270$	$+.307$	$+.333$
5	$+.044$	$+.075$	$+.103$	$+.131$	$+.168$	$+.196$	$+.213$	$+.228$
7	$+.035$	$+.054$	$+.072$	$+.092$	$+.109$	$+.127$	$+.130$	$+.130$
9	$+.026$	$+.036$	$+.041$	$+.050$	$+.054$	$+.060$	$+.066$	$+.070$
11	$+.013$	$+.013$	$+.012$	$+.012$	$+.013$	$+.013$	$+.013$	$+.012$
13	$-.007$	$-.008$	$-.013$	$-.022$	$-.028$	$-.036$	$-.040$	$-.041$
15	$-.023$	$-.027$	$-.036$	$-.048$	$-.067$	$-.077$	$-.087$	$-.097$
17	$-.041$	$-.047$	$-.059$	$-.077$	$-.098$	$-.120$	$-.133$	$-.145$
19	$-.057$	$-.068$	$-.083$	$-.103$	$-.126$	$-.157$	$-.180$	$-.200$
21	$-.076$	$-.090$	$-.108$	$-.132$	$-.157$	$-.194$	$-.227$	$-.267$
23	$-.107$	$-.117$	$-.139$	$-.167$	$-.190$	$-.220$	$-.264$	$-.317$

Nearly the same results should be reached by starting with the declination for the argument, using the values of Δa in the horizontal columns. With the corrected values thus obtained, curves representing these residuals were drawn with the right ascension as the argument.

Proceeding in this order, we obtain finally the values of Δa given in

TABLE IV.

h.	$-5°$	$+5°$	$+15°$	$+25°$	$+35°$	$+45°$	$+55°$	$+65°$
	s.	s.	s.	s.	s.	s.	s.	s.
1	$+.050$	$+.117$	$+.185$	$+.245$	$+.310$	$+.355$	$+.388$	$+.418$
3	$+.043$	$+.092$	$+.145$	$+.194$	$+.238$	$+.268$	$+.296$	$+.316$
5	$+.036$	$+.073$	$+.109$	$+.138$	$+.168$	$+.188$	$+.208$	$+.224$
7	$+.030$	$+.058$	$+.073$	$+.086$	$+.098$	$+.110$	$+.126$	$+.127$
9	$+.025$	$+.033$	$+.038$	$+.040$	$+.043$	$+.047$	$+.050$	$+.052$
11	$+.013$	$+.012$	$+.009$	$+.006$	$+.000$	$-.004$	$-.006$	$-.007$
13	$-.004$	$-.009$	$-.016$	$-.023$	$-.037$	$-.042$	$-.047$	$-.054$
15	$-.019$	$-.028$	$-.040$	$-.053$	$-.067$	$-.080$	$-.098$	$-.120$
17	$-.036$	$-.048$	$-.064$	$-.080$	$-.099$	$-.118$	$-.136$	$-.153$
19	$-.054$	$-.070$	$-.088$	$-.107$	$-.134$	$-.160$	$-.183$	$-.200$
21	$-.066$	$-.090$	$-.114$	$-.137$	$-.167$	$-.188$	$-.213$	$-.240$
23	$-.086$	$-.114$	$-.142$	$-.166$	$-.198$	$-.228$	$-.24s$	$-.300$

It will be seen that there is a substantial agreement be-
tween the values in Tables III. and IV. These values have
been derived directly from the curves, and no attempt has
been made to smooth them by the differences. Inasmuch as
it will rarely, if ever, happen that the periodicity in both
directions is as great as in this example, the agreement of
the values may be taken as an index of the magnitude of the
errors likely to be introduced through the process of drawing
the curves. It will not escape attention, that in this case,
at least, the values in the two tables differ systematically
at certain points. It is the experience of the writer, that
the periodicity thus introduced sometimes amounts to one-
fourth or one-fifth as much as the systematic deviation of
the catalogue compared from the normal system.

[*To be Continued.*]

*List of Auroras seen at the the Washburn Observatory, 1881–
2–3.* (OBSERVERS, EDWARD S. HOLDEN, AND G. M. CON-
RADSON.)

NOTE: The times are Chicago mean times.

1. 1881. Dec. 10. Through a break in the clouds an aurora
was seen about 9^h for 10^m. It was some $15°$ high
and looked rosy. All cloudy after 9^h 30^m.

2. 1881. Dec. 23. Low auroral arch first seen 6^h 30^m, 10^h
35^m much fainter. Still a faint arch 12^h 30^m.

3. 1882. Jan. 11. Low auroral arch first seen 8^h 27^m.

4. 1882. Jan. 19. Low auroral arch first seen 6^h 30^m.
Double arch about 9^h 6^m. Aurora stil present
about 12^h.

5. 1882. Jan. 27. Aurora first seen 6^h 32^m. End 9^h 50^m. Not
very bright.

6. 1882. Jan. 31. Dense clouds. At 6^h 5^m a large rosy patch
of Aurora (!) was seen in the N. E. at an altitude of
about $10°$. At 6^h 6^m the clouds had covered it [It
is quite possible that this was due to fires of brush-
wood, as I have since seen such cases.]

7. Feb. 5. Auroral arch $10°$–$12°$ high. First seen 6^h 45^m.
Disappeared at 7^h 45^m.

8. Feb. 9. Aurora with streamers. First seen 10^h 3^m.

9. April 16.   At 9^h 24^m a fine auroral arch first seen.   All
white and a simple arch.   This continued moving
upward, and at 9^h 36^m included *Polaris*.   Between
10^h and 11^h it formed a splendid corona with rays
to all parts of the horizon.   At 11^h 24^m it was the
brightest and most magnificent display I have ever
seen.   There was rather less rosy color in it than
in displays of the kind which I remember.   The
telegraph wires between Chicago and New York
could not be worked.   Between Chicago and St.
Paul a few messages were sent by the atmospheric
electricity alone.

See *Nature*, May 18, 1882, for an account of the
magnetic disturbances. Also—Note on the aurora of
April 16-17, by H. C. Lewis, Trans. Amer. Phil.
Soc., April 21, 1882.

10. April 20. 8^h 20^m auroral arch, altitude of $14°$, 10^h 0^m
3 streamers upwards; 10^h 5^m almost vanished: 10^h
50^m arch as at 8^h 20^m; 11^h 10^m, 5 bright streamers.

11. May 14.   Faint aurora seen at 12^h 30^m low down.

12. June 12.   Auroral arch; first seen 11^h 14^m.

13. June 14.   Bright aurora, first seen behind clouds 11^h.

14. June 15.   Auroral arch; dark segment, streamers; first
seen 11^h 30^m.

15. July 16.   Aurora.   First seen 9^h 50^m.   Streamers 10^h 0^m.
Simple arch 10^h 15^m, low arch spreading, both east
and west, 11^h 20^m.

16. Aug. 9. 10^h, no aurora; 11^h 35^m low arch; 12^h arch was
brighter and higher.

17. Aug. 16.   Faint aurora 10^h 0^m, brighter at 11^h 30^m, gone
at 12^h.

18. Aug. 21.   Bright aurora, 10^h 45^m.   Streamers and some
rosy color, 11^h to 11^h 30^m.

19. Sept. 3.   Bright aurora with streamers about 9^h.

20. Sept. 11.   Bright aurora first seen 9^h 0^m.   Sky clouded
later.

21. Oct. 16.   Auroral arch first seen 7^h 40^m.   Still visible
11^h 40^m.

22. Oct. 30. 6^h 30^m. Large aurora seen through heavy clouds. Raining.
23. Nov. 13. Bright aurora.
24. 1882. Dec. 15. Aurora 11^h 0^m to 12^h 30^m.
25. 1883. Feb. 4. Aurora behind clouds, pretty bright, 12^h 30^m.
26. July 29. Bright auroral arch and streamers 50° high, far in the west and east also, 10^h.
27. Jnly 30. Low auroral arch—no streamers between 9^h and 10^h.
28. July 31. Low arch; streamers at 9^h ; low arch at 12^h.

The preceding notes of the presence of auroras are such as have been made during my observations in the dome of the Washburn Observatory, and naturally they include but a portion of the auroras which must have been visible. The auroras in this list must have been bright enough to attract my attention as I was passing the north window of the dome, or else intense enough to affect the appearance of the stars in that peculiar way which observers learn to associate with auroral disturbances. Many of them in fact have been predicted, as it were, by the appearance of the stars in the telescope, which has been nearly always pointed to the south in the meridian. I should think that at least three-fourths of such predictions have been verified.

<div align="right">EDWARD S. HOLDEN.</div>

Washburn Observatory,
University of Wisconsin, Madison,
1883, July 31.

Memorandum Requested by the Committee on Kosmic Time and Prime Meridian, appointed by the International Institute for Preserving and Perfecting Weights and Measures, (CHARLES LATIMER, C. E., *Cleveland, Ohio*)—*by Professor* PIAZZI SMYTH, *Astronomer Royal for Scotland.*

These subjects, viz., a Prime Meridian for the world, Longitude and Time, so very clearly, as well as urgently, set forth by the above Committee in their circular of May 8, 1883, are the same which have already reached me in doc-

uments in greater length from both the Royal Society of Canada and the American Society of Civil Engineers, and were answered by me separately to each of those parties.

For the third time therefore of answering, I have now reconsidered the whole case, and have come, if anything, still more definitely to the same conclusion as before, touching at least the one most important of all these topics, viz., a Prime Meridian for all mankind from this time henceforward! Where it should be? For what reasons? And with what advantages?

Four candidatures are stated in the above papers, viz., Alaska, Washington, Greenwich, and the Great Pyramid of Gizeh.

The claims of the Alaska Meridian, by those who advocate it, are, that its whole length from north to south, save a short trip of nearly uninhabitable land bordering on the Polar circle, passes over deep ocean surface, where nothing can be fixed, nothing exactly known, nothing certainly referred to, and no territorial possessions be enjoyed by any nation whatever!

How these negative qualities can be considered an advantage for enabling the exact science of modern times to trace out a definite, easily distinguishable, and permanent "Prime Meridian line,"—from, and in terms of, which every existing government in the whole world is to measure its difference of longitude with surpassing accuracy,—is beyond my comprehension. For in philosophy as in science, in practice as well as theory, in common sense as well as learning, in exertions of muscle as well as brain, all safe progress has been hitherto held to consist in beginning with the known and working thence towards the unknown. I cannot, therefore, feel the smallest sympathy for those who are endeavoring to procure the honor of becoming the one, universally-to-be-adopted, Prime Meridian of the modern world, for an intangible line, passing over nothing but moving, ephemeral, unidentifiable waves of a distant ocean, and including an unworkable principle, entirely opposed to the history of human progress.

In coming next to Washington, D. C., we abandon all
the manifest impossibilities, and even absurdities, of Alaska.
For a notable portion of the Washington Meridian line, be-
sides its own great city, lies in a very glorious and advanc-
ing country; viz., the United States of North America;
pushes on thence northward through Canada, and cuts on a
small portion of South America as well.   But it is alto-
gether one-sided to the United States themselves; represents
effectively only one race, government, and language, of the
many which do exist in the world, and speaks of nothing
but the present time in history.

In that last respect, Greenwich, though representative of
Great Britain, cannot claim much more; for a mere 300
years past would cover all its scientific renown; and though
nearer by the breadth of the Atlantic to the general polity
of nations, than Washington, yet is it, with that city, too
far in the west to be fairly representative of either the two
hundred millions of souls of fellow subjects governed by the
British in India, or of the many hundred millions ruled over
by Russia, China and Japan.   These countries are indeed
often said to contain the greater part of the human race;
that race for whose benefit in the aggregate we are told that
the question of chosing a Prime Meridian for this planet
has just now been brought so energetically to the front.

Lastly, therefore, we are driven by the above failures to
take into consideration the Meridian of the Great Pyramid
of Gizeh in Egypt; but happily find there a very antithesis
to the negations of Alaska, as well as singularly complete
supplements to the evident short-comings of both Washing-
ton and Greenwich.

For, the Meridian of the Great Pyramid passes over solid,
habitable, and for ages inhabited, land through nearly the
whole of its course from north to south.   Its line is capa-
ble therefore of being laid out along almost all that dis-
tance by trigonometrical measurement, and marked by
masonried station signals; and that is the only unquestion-
ably accurate, permanent, and sufficiently visible method
of setting forth the one base for longitude-measuring in
the future before all varieties of men.

The Great Pyramid itself, not on the unhealthy Equator, but near the land middle and most agreeable climate of that long Meridian line, has occupied its position, indexed too remarkably by Nature, through more than 4000 years; and after all that lapse of time and growth of science therein, is acknowledged to be still, above its other high fulfillings, the grandest, as well as best built surveying station-mark and monument that has ever been erected the whole world over. It positively dates from before all human written history, all known architecture, all living language, and has seen all the successive great nations of mankind come before it, but has succumbed to none.

Its meridian, moreover, divides the lands and numbers of the people of the earth much more nearly than any other. And though that central, or lower Egyptian portion of the long line had somehow got to be deemed during two or three recent centuries rather difficult of access,—more so than it was in those earlier days of little galleys, easy of portage or coast navigation with slave-driven oars,—yet now the cutting through of the Isthmus of Suez (already by one ship-canal and prospectively by another, to relieve the growing plethora on the first), joined to the marvellous development of those world's face-changing features of modern times, steam navigation and the electric telegraph, is restoring to practical use the grand natural facilities long since offered by the primal geographical features of that part of the world. Indeed these things are making the Egyptian neighborhood day by day a more frequent crossing, and more multitudinous place of meeting, for all nations than any other that either is, or ever has been, upon the entire surface of the earth.

There is no doubt a sea-break in the possible land-line of signals between the northernmost point of Egypt opposite the Great Pyramid, and the southern coast of Asia Minor, —which would require a little trigonometrical detour eastward by way of Syria, to get round it accurately; and so to reach the direct line again on solid land; from thence to carry it up through Turkey, Russia, and Norway to the highest available European latitudes.

But that said detour should at once remind us, that with-in its compass lies Jerusalem; the sacred city of the earth, not only with Christians, but every other non-idolatrous religion. Not very far therefore from Jerusalem ought, on any account, to be chosen the Prime Meridian of the whole world. And when we come further to consider the grow-ing probability of recent demonstration, that the site of Jerusalem has claims on all the human race—both far older than having been the city of King David, or even of Mel-chizedek, seeing that its locality witnessed the creation of Adam by God; and of far greater import in the future, than any movement now going on amongst men in any and every land,—because it is also ordained to behold, and sub-serve too, the return of the Divine Son, the Lord Jesus Christ, in power and glory, to reign supernaturally over all nations,—when we think as Christians of these momentous things now rapidly approaching,—who is there of Adamic descent, that has once learned "to call on the name of the Lord," who would try to group mankind in these latter days round a totally different centre, and make them look to the opposite side of the earth.

Observations of DR. J. JANSSEN, *Director of the Observatory at Mendon, Chief of the French Mission to Caroline Island to observe the Total Solar Eclipse of May 6, 1883.* (Trans-lated and read by, PROF. J. R. EASTMAN at the Minne-apolis Meeting of the A. A. A. S.)

SPECTROSCOPIC OBSERVATIONS.

The principal object of the author was the study of the dark lines in the corona.

In his opinion the visibility of these rays depends much more upon the light power of the instrument than upon the perfection of its images.

In accordance with these views he had a reflecting tele-scope constructed with a mirror of 50 centimetres diameter, and a focal length of 1.60 meters.

In this instrument the images of the moon are of such an

extraordinary intensity as to greatly disturb good vision.

With this telescope good images of the " lumiere cendree" can be obtained with an exposure of one minute.

This telscope was employed at Caroline Island.

The spectroscope adapted to this telescope is formed of a direct vision prism containing prisms of very pure material.

The collimator has a focal length and aperture calculated to utilize all the rays of light from the mirror.

An excellent finder is so mounted on the instrument that when one of the observer's eyes is at the finder the other is at the viewing telescope.

Before complete totality the mirror of the telescope was partly covered to prevent the solar heat from breaking the prism which directed the light into the spectroscope.

As soon as totality was nearly complete the mirror was completely uncovered and the exploration of the corona commenced.

At first the ordinary brilliant rays which the corona presents were recognized, but what was *new* and more complete than had been even expected was that the back ground of the coronal spectrum presented the complete Fraunhofer spectrum:--that is, the dark lines of the solar spectrum except those that become brilliant in the corona, like C, F, etc., and those which on account of their fineness are only visible in spectroscopes of extreme dispersion.   One remark, however, should be made here, that, considering all the circumstances and the amount of light in which the observer was placed, all the dark lines of the solar spectrum were seen that were theoretically visible.

I was so struck with this phenomenon that I called to Mr. Trouvelot, who was observing at my side, to come and see it, but his observations confined him to his post.

This remarkable phenomenon was observed in the most brilliant portions of the corona, but not of the same character, at equal distances from the sun's limb.

This indicates that there are some portions of the corona which reflect, much more abundantly than others, the light emanating from the solar sphere, which would indicate the

existence of cosmic matter circulating around the sun.

It is not proposed here to develope all the deductions from the facts obtained at Caroline Island, but we wish especially to record the occurrence of the complete Fraunhofer spectrum in the spectrum of the corona; reserving to ourselves the design of returning later to a discussion of the results relating to the constitution of the corona and the space around the sun.

I have found the coronal spectrum continues in certain lower portions of the corona.

I have studied the rings of Respeghi, but do not find them symmetrically arranged around the sun. They present some peculiarities of structure which show the complexity of the coronal phenomena, and will be discussed later.

The light of the corona was strongly and radially polarized.

All these studies, the examination of the forms of the corona, the dark rays; the rings of Respeghi and polarization were associated because of their relation to the question of circum-solar cosmic matter; and I think that the results obtained at Caroline Island, and especially the observation of the Fraunhofer spectrum in the circum-solar regions, advance this question.

PHOTOGRAPHY.

Two large pieces of apparatus were carried from France, and on them were mounted eight photographic chambers for the purpose of studying the question of intra-Mercurial planets as well as the form of the more extended portions of the corona.

One photographic apparatus has an objective of 8 inches diameter, giving a field of 15° all around the *Sun*. In a good night this apparatus gives images of stars of the 6th and 7th mag. in a few minutes. It was to be used specially in this expedition in the search for hypothetical intra-Mercurial planets.

A preliminary examination of the plates exposed indicates that nothing of the kind appeared about the *Sun* during the eclipse.

The non-existence of these important intra-Mercurial planets seem to me to be demonstrated, if not with absolute accuracy, at least with an extremely high probability.

The other apparatus had a very different light power and was designed to solve several new questions in regard to the constitution of the *Sun.*

This apparatus has shown that the corona is a phenomena, and that after a certain time of exposure the diameter of the photographic image does not increase; that images of the corona have been obtained with an objective of 4 inches with short focus and with the action of fully 5 minutes on a very sensitive gelatine plate.

The corona *then* is sharply defined and becomes sensibly equal to that obtained by the action of much weaker light.

The form of the corona is shown to be permanent during the entire totality.

Finally, my observations at Caroline Island tend to prove that no important intra-Merculiar planet exists, and that the proturbations of the planet *Mercury* recognized by LE-VERRIER ought rather to be sought in the presence of cosmic matter circulating around the *Sun.*

INTERNAL CONTACTS IN TRANSITS OF THE INFERIOR PLANETS.*

PROFESSOR J. R. EASTMAN.

The two transits of *Mercury* and of *Venus*, which have occurred during the last decade, especially those so generally observed in the United States, have awakened no little interest and speculation in regard to the phenomena attending such observations.

While we are waiting with due patience to learn the true value of the solar parallax to be deduced from the observations of the transits of *Venus* in 1874 and 1882, we

*Read at the Minneapolis meeting of the A. A. A. S., by Professor Eastman, of the Naval Observatory, Washington, D. C.

may, perhaps, profit by an examination of some of the phe-
nomena which have been considered by many astronomers,
inseperable from the observations of internal contacts.

From the observations of the transit of *Venus* in 1761
values of π were derived by different computers, varying
from, 8".2 to 10".

From the more numerous observations in 1769 the values
deduced by various computers ranged from 7".5 to 9".2.

No satisfactory result was reached, however, until ENCKE
in 1822–24 with great care and labor went over the whole
list of observations and deduced the well known value,
8".5776 which for years was accepted as the true value.

In 1835 ENCKE changed this to 8".571. Although this
quantity was used in all ephemerides and other astronom-
ical publications its accuracy was soon doubted.

There were several valid sources of this doubt, and about
100 years after the transits of the eighteenth century, sev-
eral astronomers were led to re-examine and re-reduce the
observations of 1869.

New results were obtained from the observations used by
ENCKE but differing from his value by about $\frac{1}{29}$ of the
whole amount.

From the general discussion which followed the an-
nouncement of these results and of the methods employed in
obtaining them, it became unpleasantly certain that the
numerical value of it depended chiefly upon the computer's
interpretation of the observer's record.

From the earliest observations, most of the observers had
been more or less baffled by a phenomenon generally known
as the "black drop," or "dark ligament," which at or about
the expected times of internal contact had appeared be-
tween the limbs of the *Sun* and *Venus*, and rendered the re-
corded times of the contacts uncertain to the extent of fif-
teen or twenty seconds.

As the "black drop" was generally seen by those who
observed the transits of the eighteenth century, the inter-
pretation of the recorded observations was the principal
problem which challenged the skill of those astronomers

who attempted a new discussion of the observations of 1769.

POWALKY seems to have adopted no rule for explaining the meaning of the records, rejecting such as he deemed discordant, and in 1864 he deduced a new value of $\pi = 8.''832$.

STONE, after a careful study of all the records adopted a rigid rule for interpreting the records in all cases where the "black drop" was seen, and from his discussion obtained the value $8.''91$.

STONE concluded [that the "black drop," or some modification of it was a necessary phenomenon whenever a black disk like *Venus* or *Mercury* was seen against the bright surface of the *Sun*.

In 1868 Mr. STONE said,—"The apparent diameter of the *Sun* is increased, and the apparent diameter of *Venus*, whilst on the *Sun's* disk, is decreased from the same causes which produce the spurious disk of a star in the focus of a lens.   When the true limb of *Venus* falls in a line with the true limb of the *Sun*, the light is cut off, the spurious enlargement of the disk *Sun's* and encroachment on that of *Venus* is destroyed at the point of contact, and, as a consequence, a dark ligament appears to connect the apparent limbs of the *Sun* and *Venus*.   This is the real internal contact.   The breadth of the connecting ligament rapidly increases, and after some $18°$, the exact interval depending upon the circumstances of the transit and the success in first catching phase (1), [the real internal contact], the limbs of *Venus* and the *Sun* will appear in contact.   This is the second phase for accurate observation, the apparent internal contact.''

This quotation from Mr. STONE expresses very fairly the opinion of those who believe that the "black drop" is, from the nature of the circumstances, a natural and necessary phenomenon.

In 1876 M. ANDRE, the astronomer who had charge of the French expedition to Noumea in 1874, to observe the transit of *Venus*, announced as the result of analytical in-

vestigation, and of a long series of experiments made by himself, that

"The bridge, black ligament, or "black drop', as it is variously called, is a necessary phenomenon under certain circumstances, and not merely accidental. With an unchanging source of light of sufficient brilliancy the angular dimensions of the ligament are inversely proportional to the diameter of the object-glass, and with an aperture of five inches the drop is scarcely perceptible Diaphragms should never be used when observing *Venus* in transit as the apparent dimensions of the drop are augmented by any increase in the focal length."

"It is always possible to get rid of the ligament and re-reduce the phenomena to 'geometrical contacts,' either (*a*) by reducing sufficiently the intensity of the source of light or augmenting the absorbing power of the dark glass employed; or, again (*b*) by covering the object-glass with a net-work diaphragm composed of rings alternately full and empty, and all very thin, but bearing a certain proportion to the focal length of the lens."

These results and opinions of M. ANDRE were not generally known at the time of the transit of *Mercury* in 1878, though ANDRE traveled from Paris to Ogden, in Utah, to test his results, from analysis and experiment by actual observation. His theories were confirmed by his observations in 1878, and in 1881 he published his results more fully, together with the details of his experiments.

In 1878 the necessity of the "black drop" phenomena was generally recognized, and it was seen by many observers of the transit of *Mercury*. Some who saw it evidently considered their success in finding it an evidence of the good quality of their observations.

In a few cases observers apologized for failing to see the "black drop."

One fact, however, was worthy of notice, that every observer, so far as I could ascertain, who was accustomed to observe the limbs of the *Sun* for position; or, in other words, to get by means of the shade-glasses, best definition of the *Sun's* limbs with an illumination somewhat less

than the eye could easily bear, did not see any trace of the "black drop."

Although I had then seen no account of ANDRE'S experiments, and had given but little attention to his deductions as announced in the Royal Astronomical Society by Father PERRY, I was convinced after my observation of the transit of *Mercury*, in '78, that the theory of a necessary "black drop" was fallacious. As I had been able to make only one experiment, the data to sustain my belief, from my own observations, were very meagre, and I waited four years for another opportunity. Many other observers in 1878 failed to see the obstructing phenomenon, but out of the various descriptions of the contact observations I did not find the exact data which I desired as proof.

The experience gained in the observations of May 6, 1878, and from the subsequent discussions of the results, were probably not without their effect in the observations of the transit of *Venus*, in December, 1882, for I have yet to learn of any observer in the eight American parties organized by the Transit-of-Venus-Commission, who saw any trace of the "black drop;" while in 1874 many of them report such phenomena.

Last December, at the Transit-of-*Venus* station, at Cedar Keys, Florida, the observation of first contact was prevented by a cloud which covered only a small portion of the *Sun's* disk. This cloud soon disappeared and the illumination was reduced, with the sliding shade glass, until the brightness was considerably less than could be easily borne by the eye, while the definition of the *Sun's* limb was perfect. The *Sun* was surrounded by haze and thin cirri which increased the steadiness and definition of the limb, and permitted the use of a less dense shade-glass.

The definition and steadiness of *Venus* was all that could be desired, and there was no modification, at the limbs, of the dense black color of the disk.

The diameter of the objective was five inches, and the the whole aperture was used. The eye-piece magnified 216 diameters, and was used in connection with a Herschel solar prism. The shade-glass was a wedge of neutral tint,

mounted against a similar wedge of plain glass in a thin brass frame, the whole sliding freely in a slotted cap for the eye-piece.

My attention was of course directed, *first* to fixing the exact time of contact; *second* to looking for the " black drop" and its modifications, or for any change in the tint of *Sun's* limb at that point of contact.

The entire disk of *Venus* was visible for several minutes before second contact and the portion beyond the *Sun's* disk was bordered by a narrow line of light much less bright than the limb of the *Sun*, and of a brighter tint.

The progress of the transit was strikingly barren of notable events. About one minute before the contact, the apparent motion of the cusps of the *Sun* as they closed around the planet was noticeably increasing though the movement was the perfection of steadiness.

I had not long to wait, for the cusps rapidly swept around the body of the planet in a perfectly steady line of sunlight of the same tint as the adjacent parts of the *Sun*. This line was as narrow as I could see with a power of 216, and was free from any tremors or pulsations.

There was not the slightest agitation of the limbs of either body near the point of contact, and no trace of any "black drop," ligament or band.

There was no change of color or tint on the limb of *Venus* near the point of contact and no indication of any clinging of the limbs.

The contact was as easily, and I think as accurately observed as the transit of a star within 8° of the pole under the best condition. The uncertainty of noting the time of the visible contact could not be greater than three-tenths of a second.

The phenomena at the third contact were similar to those at the second in the reversed order.

From my own experience then, and in 1878, as well as from the work of other observers, I am thoroughly convinced that with a properly arranged telescope and shade-glasses no good observer need have any trouble from any phase of the "black drop." It must not be forgotten that

the observer of contacts has but a single purpose in view. He has not time to devote to the study of any branch of solar physics, he is simply to obtain a good definition of the *Sun's* limb as a reference point in the passage of the limb of *Venus*. Searching for some new thing detracts from the value of his proper work.

If it should be urged that the light should be as strong as the eye can bear, thereby producing all the troublesome phenomena that diffraction or irradiation will give at the limit of vision, why not simplify the process by discarding shade glasses and all aids to good vision, and see,—nothing that is trustworthy.

THE GREAT COMET OF 1882.

PROFESSOR E. FRISBY.

[We are glad to avail ourselves of the following interesting facts furnished recently by Professor E. Frisby, Washington, D. C., respecting the orbit of the Great Comet of 1882. Such varied views have been held by astronomers touching its period that his remarks will be deemed helpful in determining this element.—ED.]
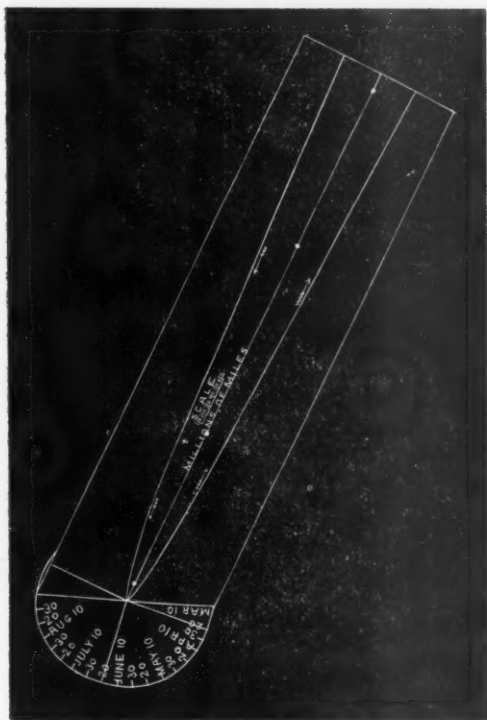
The observations chosen were made on Sept. 19, Oct. 8 and Nov. 24, and it became very interesting to know how nearly this orbit represented the different observations.

The correction to the first observation made at the Cape of Good Hope when the comet was 155° the other side of perihelion was only

$$
\begin{array}{lll}
 & s & '' \\
 & - 0.50 \text{ and} & + 1.4 \\
\text{Dec. 11,} & + 1.18 \text{ ``} & + 18.7 \\
\text{Feb. 2,} & + 2. - \text{ ``} & + 12. - \\
\text{April 4,} & + 4. 06 \text{ ``} & + 14.
\end{array}
$$

It should, however, be borne in mind that the last observations was compared with a bright portion on the comet near the following end by mistake; if compared with the middle part of the nucleus, the correction would be less than 3^s in R. A., the ephemeris place actually passing very near to the preceding part of the nucleus. The period obtained from these observations is about 793 years. Dr. Kreutz's elements give 852; another gives 822 years. Dr. Morrison's

elements, computed from observations of Sept. 14, Sept. 19, Oct. 8, and Feb. 28, gives a period of 997 years; the difference between 793 and 997 years is considerable, but the elements agree very closely.

(Frisby's orbit of the Great Comet.)

FRISBY.

$\Omega = 346° \ 1'7''.91$
$\pi - \Omega = 69 \ 36 \ 12.79$
$i = 141 \ 59 \ 52.16$
$\varphi = 89 \ 13 \ 42.70$
$\log a = 1.9331366$
$\log q = 7.8904739$
$T = 793.869$ ys.

$346° \ 2'.2$
$69° \ 37.2$
$141° \ 59' \ 52''.2$

1882.0

MORRISON.

$346° \ 2' \ 29''.0$
$69 \ 37 \ 27.7$
$141 \ 59 \ 52.3$
$\log e = 9.99992163$
$\log a = 1.9992346$
$\log q = 7.8922566$
$T = 997.36$ ys.

1883.0

EDITORIAL NOTES.

The thirty-second annual meeting of the American Association for the advancement of science convened at Minneapolis, August 15. and continued its sessions in the usual way for one week. The atten-·lance in membership was something over 300, and the various sections were nicely accommodated in the spacious rooms of the State university building, either for simultaneous work or for general conference.

The officers of the Association were as follows:

President, C. A. Young of Princeton. Vice Presidents, A. Mathematics and Astronomy—W. A. Rogers of Cambridge; B. Physics—H. A. Rowland of Baltimore; C. Chemistry—Edward W. Morley of Cleveland; D. Mechanial Science—(Absent); E. Geology and Geography—C. H. Hitchcock, of Hanover; F. Biology—W. J. Beal, of Lansing; G. Histology and Microscopy—J. D. Cox, of Cincinnati; H. Anthropology—O. T. Mason, Washington; I. Economic Science and Statistics—F. B. Hough, of Lowville; Permanent Secretary, F. W. Putnam, ot Cambridge; General Secretary, J. R. Eastman, of Washington; Assistant General Secretary, Alfred Springer, of Cincinnati; Secretaries of the sections, A. Mathematics Astronomy—G. W. Hough, of Chicago; B; Phpsics—F. E. Nipher, of St. Louis; C. Chemistry—J. W. Langley, of Ann Arbor; D. Mechanical Science—[Resigned;] E. Geology and Geography—Alexis A. Julien, of New York; F. Biology—S. A. Forbes, of Normal; G. Histology and Microscopy—Carl Seiler, of Philadelphia; H. Anthropology—G. H. Perkins, of Burlington; I. Economcis Science and Statistics—[Absent;] Treasurer, William Lilly, of Mauch Chunk.

The papers and discussions of this meeting compare well with those of the last two Annual Assemblies, if it be remembered that the attendance at Minneapolis was only about one third that at Montreal last year.

Something of the character of the work done may be known by glancing at the titles of the more prominent papers which claimed the attention of those interested in Astronomy. They were as follows:—

The Total Solar Eclipse of May 6, 1883. (20m.)....Edw. S. Holden.

A new method of investigating the flexure corrections of a
    Meridian Circle. (12m.).........................W. A. Rogers.

On an improved method of producing a dark-field illumin-
    ation of lines ruled upon glass. (8m.)............W. A. Rogers.

Results of tests with the Almacantar, in Time and Latitude.
    (5m.)........... ....S. C. Chandler, Jr.

Internal contacts in Transits of Inferior Planets. (12m.)J. R. Eastman.

Physical phenomena on the planet *Jupiter*. (30m.).....G. W. Hough.

Observations of the Total Solar Eclipse of May 6, 1883..Dr. J. Janssen
Some hitherto undeveloped properties of Squares. (25m.)
                                                    O. S. Westcott.
On the light variations of T. Monocerotis. (5m.)......E. F. Sawyer.
Orbit of the Great Comet of 1882. (15m.) ....Edgar Frisby.
The Rotation of Domes: (10m.)...............G. W. .Hough.
Observations on the Transit of *Venus* made at Columbia Col-
    lege, New York City. (10m.) ....J. K. Rees.
Description of new Observatory of Columbia College. (15m.)J. K. Rees.
Definitive determination of the relation,
    Imperial yard,+3.37030=the meter of the Archives.
    (16 m.)....... ....W. A. Rogers.
Some observations on *Uranus.*
    (5 m.)....... ....C. A. Young.
    From time to time, the above paper, or abstracts of them, will ap-
pear in these pages with a brief outline of the discussions accompany-
ing them.

The entertainment furnished to the members of the Association
by the city of Minneapolis was unusually generous and every way
complete. Free lunches were daily served on the University campus,
to which all members, and all visitors not members, were cordially
invited. All the time that could be given to excursions was industri-
ously used in enjoying the courtesies of the railway companies, for
banquets and sight-seeing at Minnetonka, St. Paul, Minnehaha, Fort
Snelling, Taylor's Falls and proffered trips to Winnepeg and the Yel-
lowstone Park.

The friends of science in the West esteem the Minneapolis
meeting of the Association one of great value to all this new and
rapidly growing section, and they look for and expect a few years
hence, a return visit, with larger numbers and increasing attractions.

The nominating committee submitted the following list of officers,
which was declared elected in the usual way:

President—Prof. J. P. Leslie, of Philadelphia.

General Secretary—Dr. Alfred Springer, of Cincinnati.

Assistant Secretary—E. S. Holden, Madison, Wis.

Section A—President, H. T. Eddy, Cincinnati; Secretary, G. W.
Hough, Chicago.

Section B—President, John Trowbridge, Cambridge, Mass.; Sec-
retary, D. C. Hodges, Salem, Mass.

Section C—President, John W. Langley, Ann Arbor, Mich.; Sec
retary, Robert B. Warden, North Bend, Ohio.

Section D—President, R. H. Thurston, Hoboken, N. J.; Secretary,
S. Burkett Webb, Ithaca, N. Y.

Section E—President, N. H. Winchell, Minneapolis; Secretary.
Eugene Smith, Tuscaloosa, Ala.

Section F—President, E. D. Cope, Philadelphia; Secretary, C. E. Bessey, Ames, Ia

Section G—President, D. G. Wormley, Philadelphia; Secretary, Romyn Hitchcock, New York City.

Section H—President, E. S. Morse, Salem, Mass.; Secretary, W. H. Holmes, Washington, D. C.

Section I—President, John Eaton, Washington, D. C.; Secretary, C. W. Smiley, Washington, D. C.

Treasurer—William Lilley, Mauch Chunk, Pa.

The standing committee also submitted a report recommending that the next annual meeting be held at Philadelphia, September 3, 1884, which was adopted.

BARNARD'S COMETARY MASSES.

Numbers 8 and 9, Vol. 1 of the MESSENGER contain a full series of observations of the great comet of 1882 made by Mr. BARNARD, of Nashville, from September 22 to November 1, with drawings showing the three bright patches in the nucleus, and the curious train pointing towards the *Sun*, seen October 14, and for several days following.
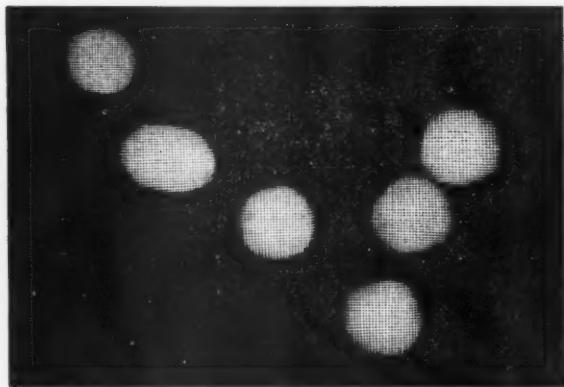
Under date above mentioned Mr. BARNARD gave account of very interesting observations of six cometary masses, near one another, and within about six degrees south by west of the large comet's head. Their appearance as shown in the cut above (reversed view) was that of distant telescopic comets, with slightly brighter centers, and so near that several were in the field at once. We are indebted to Mr. BARNARD for the above drawing which forms an important part of the history of that wonderful comet.

Dr. RALPH COPELAND of Lord CRAWFORD'S observatory, Dun Echt, Scotland, went to Jamaica to observe the late transit of *Venus;* thence to Peru spending several months there. Recently he has visited the Dudley, Litchfield and Warner observatories, and while at the latter place, jocosely expressed himself as "very anxious to be taken to the cider mill where Professor SWIFT discovered five comets."

Professor TROUVELOT, a member of the French eclipse expedition to Caroline Island, on his return visited the Warner observatory. He gave Professor SWIFT interesting tidings regarding a supposed observation of an intra-Mercurial planet.

Some unkind and very unjust things have been said in the daily papers occasionally respecting Mr. WARNER'S motives in offering the comet prizes. Men of intelligence and of sense will say, that Mr. WARNER has a right to use his money as he pleases in lawful ways; and if he chooses to devote it to the furtherance of science, as he has done in various ways in late years, his public spirit in this thing is praiseworthy, and it is so recognized generally. The special prize of $250 recently awarded to Professor WM. R. BROOKS, of Phelps, N. Y., for astronomical discoveries certainly looks that way in as much as his work was not covered by the general prizes.

Professor C. A. YOUNG of Princeton, has made some observations by the aid of the great equatorial during the last year, to determine the figure of the planet *Uranus.* The results show its ellipticity to be about $\frac{1}{20}$. The observations also show that there also exists on the planet's surface apparent dents or marks that might possibly be used to determine the period of rotation. The considerable ellipticity of the body would seem to indicate a high rate of rotation.

Concerning the new theory of the *Sun's* corona advanced by Dr. C. S. HASTINGS of Baltimore, most astronomers properly have little to say up to the present time. When his official report is published, which will contain a full statement of the observations at Caroline Island and the arguments for the new theory, then competent scholars will be able to judge of its merits, and it will receive, as it deserves, a thorough investigation by them in all parts of the world. For the true scientist, it is yet too early to offer an opinion as to its falsity that is either safe, or wise or courteous, much less to treat its early announcement in a frivolous way.

The corona of the *Sun* has not yet received an explanation that meets the approval of astronomers generally. The opinion seems to have weight that the phenomenon is due, partly, to meteoric substance, and partly to a self-luminous atmosphere surrounding the *Sun.* Ob-

servations by the spectroscope and by the polariscope, in recent years, point strongly to these two different conditions of matter near the *Sun*, yet the evidence is neither uniform nor conclusive. Indeed, the solar physicist is so little acquainted with the behavior of any matter in so high temperature as that near the solar photosphere, that he labors under great difficulties to construct a theory that will account for the phenomena that ought to be expected. The theory of diffraction proposed by Dr. HASTINGS is totally different from every other one. It is simple, and ought to be susceptible of mathematical proof.

DEFINITIVE DETERMINATION OF THE ORBITS OF SIX OF SATURN'S SATELLITES AND OF THE MASS OF THE PLANET.

Dr. W. MEYER of Geneva, has been engaged since 1880 in the investigation of the Saturnian system. From his earlier observations he obtained provisional elements of Enceladus, Tethys, Dione, Rhea, Titan and Japetus. These were compared with observation and 326 equations of condition obtained which were rigorously treated. The mean motions are derived from comparisons with the observations of JACOB and BESSEL. The mean errors of the various elements for each satellite are exhibited in a table and they show the effect of perturbation, which of course they should. A table giving the comparison of the final theory and the observations shows that these latter are well represented. A comparison of BESSEL's elements of Titan and MEYER's is confirmed by the results published by HALL. The secular variations of the node and peri-saturnium are deduced from this comparison, as well as the corresponding data for Japetus from a comparison with TISSERAND's orbit. Each satellite gives the value of the mass of *Saturn* which are exhibited in the following table:—

<div align="center">

MASS.

Enceladus:	0.000 284213
Tethys:	.000 288215
Dione:	.000 288531
Rhea:	.000 288898
Titan:	000 287204
Japetus:	0.000 285849

</div>

Having respect to the weights, the final mass of *Saturn* is, $M=3482.9 \pm 5.5$; BESSEL's result for the mass of the ring, in terms of that of *Saturn*, was $\frac{1}{118}$; MEYER's result is $\frac{1}{119}$.

In a recent paper by LINDEMANN in the Memoirs of the Academy of Sciences of St. Petersburg, observations made at different times and by different persons with the Zollner photometer and colorimeter are compared, and the conclusion reached that the changes supposed to take place in the brightness of red stars not exceeding one magnitude must in most cases be looked upon as very questionable. Although it is generally conceded that estimates of the brightness of red stars are

more unreliable than those of stars having other colors, a careful in-
spection of LINDEMANN'S paper will show that in assuming that the
error arising from the comparison of two stars of the same color is
practically nothing as compared with the error arising from the com-
parison of two stars of different colors, and therefore that the error of
observation at a given reading of the colorimeter may be taken equal
to zero, he practically assumes as the basis of his argument the very
point he aims to prove. In fact, if the errors had been so assumed as
to make their means equal to zero for each set of observations (the
only proper *a priori* hypothesis) the best agreement would have been
found not to exist for 165° of the colorimeter, but for 20°, estimated
"rothlich" by LINDEMANN, and "roth" by ROSEN.   s.

A new Minor Planet was discovered August 12 by Prof. C. H. F.
PETERS, Clinton, N. Y. Ninth magnitude. Its position was: Clin-
ton, M. T., 13^h 49^m 27^s, R. A. 21^h 20^m 48^s. 17; Decl — 12° 29' 8".2
Daily motion A. R.—35^s.8, in Decl —. 20' 50".

The article describing the solar eclipse of May 6th, which was
published in the last number of the MESSENGER, should have been
credited to the *Boston Advertiser.*

Attention is called to the advertisement of a Zollner's Photometer,
found on the second page of the cover of this issue. Correspondence
is solicited.

A zealous friend, whose quick eye has seen the need of more books
for the astronomical library of our observatory, has generously donated
$200 for this purpose.

We have been unable to find any late observations showing the min-
imum of the variable star Algol. Any astronomer furnishing such
data will confer a favor.

BOOK NOTICES.

Recreations in Astronomy, with directions for practical experiments
and telescopic work; by Henry White Warren, D. D., author of
"Sights and Insights," etc.; with eighty-three illustrations and
maps of stars. New York: Messrs. Harper & Brothers, Publishers,
Franklin Square, pp. 284.

This book gives a popular account of the recent progress of Aston-
omy, embracing a wide range of well-chosen topics, which are pre-
sented in Bishop Warren's own happy style The book has been pre-
pared for the general reader and the general library; and it is difficult
to see how the task of selecting matter from the broad field of astron-
omical science could have been done more wisely or more faithfully.
The principal topics are: The creative processes; Constitution of
light; Chemistry of suns revealed in light; Creative force of light;

Astronomical instruments; Celestial measurements; The sun; The planets as seen from space; Particular study of shooting-stars; Meteors and comets; Nebular hypothesis; The stellar system; The worlds and the world; The ultimate force; Summary of latest discoveries and conclusions. This book well portrays some of the highest achievements of the human mind in scientific research, and yet rightly ascribes all the glory to the Divine Mind. The author "sees no gulf that separates science and religion, nor any conflict when they stand together."

L'Astronomie, Revue mensuelle d'Astronomie populaire, de Meteorologie et de Physique du globe, par M. Camille Flammarion. Sommaire du Numero de Juin: *La chaleur solaire et ses applications industrielles*, par M. A. Lepaute. — *La constitution interieure de notre planete*, par M. Edouard Roche, correspondant de l'Institut. — *Phenomenes dus a l'action de l'atmosphere sur les etoiles filantes, sur les bolides, sur les aerolithes*, par M. G.-A. Hirn, correspondant de l'Institut,—*Distribution des petites planetes dans l'espace*, par M. le general Parmentier. — *Les etoiles o⁷ et o² du Cygne.* *Rectification a apporter aux catalogues et cartes celestes*, par M. C. Flammarion. — *Academie des Sciences.* Temperature a la surface du sol et jusqu'a 36ᵐ de profondeur pendant l'annee 1882, par MM. Ed. et Henri Becquerel. — *Nouvelles de la Science.* *Varietes:* La grande tache solaire du mois d'avril 1882. Ou commence lundi, ou finit dimanche? Curieuse etoile filante. Origine des Uranolithes. Les saints de glace, etc., etc. — *Observations astronomiques* et *Etudes selenographiques*, par M. Gerigny. — Ce Numero contient 12 figures. — Abonnement d'un an: Paris, 12 fr.; departements, 13 fr. — PREMIERE ANNEE, 1882, prix du volume: broche, 10 fr.; relie avec luxe, 14 fr. — (Librairie GAUTHIER-Villars, quai des Augustins, 55, Paris.)

BOOKS RECEIVED.

Authors or publishers sending books or papers for notice will please state, for general information, the price, and where they may be obtained.

Essentials of Geometry, by ALFRED H. WELSH, A. M., late Professor of Mathematics in Buchtel College. Messrs. S. C. Griggs & Co., Publishers, Chicago.

A new Political Economy, by JOHN M. GREGORY, LL. D.; published by Messrs. Van Antwerp, Bragg & Co., Cincinnati. pp 385.

Empyrical and Rational Psychology, by A. SCHUYLER, LL. D., President of Baldwin College. pp. 484.

The Principles of Logic, (by the same author). pp. 168.

A Complete Algebra, (by the same author). pp. 384.

Elements of Geometry, (by the same author). pp. 372.

Surveying and Navigation, late edition, (by the same author). pp. 403, with tables. All published by Messrs. Van Antwerp, Bragg & Co., Cincinnati.

A Treatise on the Principles and Applications of Analytical Geometry, by HENRY T. EDDY, Ph. D., University of Cincinnati. Messrs. Cowperthwait & Co., Publishers. pp. 112.

Physical Geography, by M. F. MAURY, LL D.; University Publishing Company, N. Y.

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